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ESTIMATE OF DRY VENEER VOLUME LOSSES IN DOUGLAS-FIR PLYWOOD MANUFACTURE

by

Douglas L. Hunt, *Forest Products Technologist*
Timber Management, Region 6

and

Richard O. Woodfin, Jr., *Wood Technologist*
Pacific Northwest Forest and Range Experiment Station

ABSTRACT

The factors presented in this report will aid the mill operator in estimating his losses of dry Douglas-fir veneer during plywood panel production. The total loss from dry veneer to trimmed panels is 16 percent. Techniques applied in the study can be used by a plywood mill to conduct similar tests and compare their results with those presented in this report.

INTRODUCTION

This report presents factors for estimating the loss of dry veneer in manufacturing plywood. The losses were measured at plywood production operations between the veneer dryer and the panel press. The factors were developed from volume loss studies at three Oregon-Washington veneer mills peeling coast type Douglas-fir.

Veneer mill production is usually expressed in terms of a given veneer thickness. The most accepted expression is square feet of veneer on a 3/8-inch basis. Factors are available that will convert a single veneer thickness to the 3/8-inch basis.

The loss factors in this report will aid the mill operator in estimating his recovery of dry Douglas-fir veneer for panel production. The volume of veneer pulled out of the dryer and stacked can be expressed in terms of final volume that will be available for layup. The factors presented here can be applied to dryer output volumes to estimate recovery in plywood panels.

METHODS

Volume recoveries and losses were measured or determined mathematically for the plywood production operations between the dryer and the press. These included the jointing-edge-gluing, reclipping, glue spreading-panel layup, and panel trimming.

The dry veneer samples to be measured at each production operation were randomly selected from veneer loads stacked at the dryers. Sample loads were selected over a 2- to 3-day period. The steps in calculating the loss factors are as follows:

Jointing-edge gluing.--Jointing is the operation necessary to prepare the edges of random width veneer strips for gluing and joining into half- or full-width sheets of veneer. The volume lost in jointing random width veneer was determined by a number of input and output tallies. Each piece of veneer in the loads of random width veneer sampled for jointer loss was measured to determine the total load width in inches. The number of pieces per load was multiplied by the kerf width (about 3/8 inch) of veneer removed by the jointer cutting head. This calculation multiplied by the total number of sample loads measured gave the inches of veneer loss due to jointed kerf. Miscellaneous losses, including breakage or mismanufacture at the jointer and veneer strips not edge-glued because they required additional clipping, were also tallied by inches of width ahead of the edge-gluing equipment.

Edge-glued full sheets that were suitable for plywood manufacture were counted at the outfeed end of the edge-gluer. The number of full sheets was multiplied by the average width per sheet.

The components of the total input to the jointing-edge-gluing operation are the sum in inches of the following: kerf loss, breakage and mismanufacture loss, pieces to be reclipped, and full sheets.

The total output from this operation is the width of the full sheets plus the width of edge-glued pieces that were less than full sheets and were to be returned to reclip. A ratio of this output to the input gave a recovery factor of 0.92527 to reflect the recovery of veneer volume at the jointer-edge-gluer (table 1).

Return for reclipping.--A total of 14.31 percent of the veneer processed through the jointing operation was returned to the reclipping

Table 1.--*Weighted average loss factors and recovery factors for dry veneer, by mill and by production operation*

Production operation	Mill A		Mill B		Mill C		Weighted average
	Factor	*Standard error*	*Factor*	*Standard error*	*Factor*	*Standard error*	
Edge-jointing and gluing:							
Loss	0.068	--	0.086	--	--	--	0.07473
Recovery	.932	±0.0158	.914	±0.0091	(1/)	--	.92527
Not returned to reclip	.841		.880				.85690
Return to reclip	.159	±.0221	.120	±.0146	(1/)	--	2/ .14310
Reclipping:							
Loss	.230	--	.268	--	--	--	.24565
Recovery	.770	±.0104	.732	±.009	(1/)	--	.75435
Trimming:							
Loss	--	--	--	--	--	--	.12059
Recovery	--	--	--	--	--	--	.87941
Patch stock:							
Loss	--	--	--	--	--	--	1.00000
Glue spreading:							
Loss	.086	--	.081	--	0.126	--	.09549
Recovery	.914	±.0084	.919	±.0052	.874	±0.0125	.90451

1/ Data not available.

2/ This is not a loss factor but indicates the percentage of jointed veneer that must be returned to the reclipping operation.

operation. This percentage expressed as a factor, 0.14310, represents the volume of edge-jointed veneer not suitable for production use until it is reclipped (table 1). It alone, of the factors developed in the study, does not represent actual volume loss. It was calculated as a ratio of the inches of veneer needing reclipping to the total jointer-edge-gluer input as defined above. The reclipping loss factor would be applied to the volume that was returned to reclip from jointing.

Reclipping.--Reclipping losses were determined only for edge-glued random width pieces. The random width input to the reclipping operation and the usable veneer output were tallied. A loss factor of 0.24565 was calculated as a ratio of the output-input tallies (table 1).

Relatively few full or half sheets required reclipping after drying. A separate factor was not developed for this loss.

Glue spreading-panel layup.--Volume loss at the glue spreader was determined by the ratio of output volume to input volume. The output volume was made by a count of the untrimmed glue-spread layers of panel size. This count was converted into total inches of width. Veneer losses in terms of overhang (veneer layers in the panel extending beyond a maximum untrimmed panel size) and discards (veneer too thin or too rough to be used) were also tallied in inches of width. Components of the input volume to the glue spreader were the sum of the output, overhang, and discard volumes. The ratio of output to input resulted in a loss factor of 0.09549 which reflects veneer loss at the glue spreader (table 1).

Panel trimming.--Untrimmed plywood panel width was approximately 52 by 100 inches, but it varied with each mill. An average factor for trimming was calculated for each study by multiplying trimmed panel length by width and then dividing by the dimensions of the average untrimmed panel size for each mill. All individual mill factors were combined to obtain an average trimming loss factor of 0.12059 (table 1).

Patch stock production.--Patch stock is strips of veneer 3 to 4 inches wide from which plugs and patches are cut to use in upgrading sheets of veneer and in repairing plywood panels. Experience at plants peeling Douglas-fir has indicated that much of the patch stock comes from half sheets of A grade veneer. The entire production of this veneer grade and size is commonly used for patch stock. Therefore, half sheets of A veneer were included as patch stock input volume but considered to be consumed for patch stock, yielding no output volume. All half sheets of A grade veneer are included in the patch stock loss factor of 1.00000 (table 1).

DISCUSSION

The volume loss factors (and compliment recovery factors) developed from the above procedures for each mill in the study, and the weighted averages are shown in table 1. The weighted factors are the ones to apply.

Although the factors were developed at the major points of veneer loss, it is evident that not all veneer grade items suffer each loss. For instance, random width, 50-inch core stock veneer is not jointed so does not incur any jointer kerf loss. Therefore, veneer grade items would be grouped according to the manufacturing procedures they would undergo and the appropriate factors applied to each group.

General practice in the plywood industry is to edge-joint and glue 102-inch random width veneer. Most of this is in grades A through C.[1/] The volume of random width grade D veneer that is edge-glued is unknown but small; nearly all of this material is cut in half for 51-inch-long plywood core stock. Accordingly, volumes of 102-inch random width material expected to be edge-jointed were summed for all studies. This total volume was reduced by the jointing factor (0.07473) which represented kerf and discard loss.

The two no-loss factors were then applied to this reduced volume. These were expressions of the proportions of jointed veneer that must be returned for reclipping (0.14310) and that which is ready for panel layup (0.85690). The volume of veneer (85.69 percent) that went directly to panel layup was then further reduced by a factor to account for panel trimming loss (0.12059). The veneer that was returned to the reclip operation was reduced by a factor (0.24565) which represented the veneer loss from the total reclip input. The reclip output was again reduced by the jointing factor since it would be sent back to the edge-gluer. It was assumed that none of this veneer would again return to the reclip.

The full-sheet output volume from the edge-gluer is ready for panel layup. This volume, reduced by the trimming factor (0.12059), accounts for the loss in trimming veneer sheets to panel size. The sum of the volumes after trimming is the total output volume. An example of the procedure is shown below and illustrated by figure 1. It is based on the recovery factors applied to 200,000 square feet of random width, 102-inch veneer, 3/8-inch basis.

1/ National Bureau of Standards, U.S. Department of Commerce. U.S. Product Standard PS 1-66. Product Standards Section. 1966.

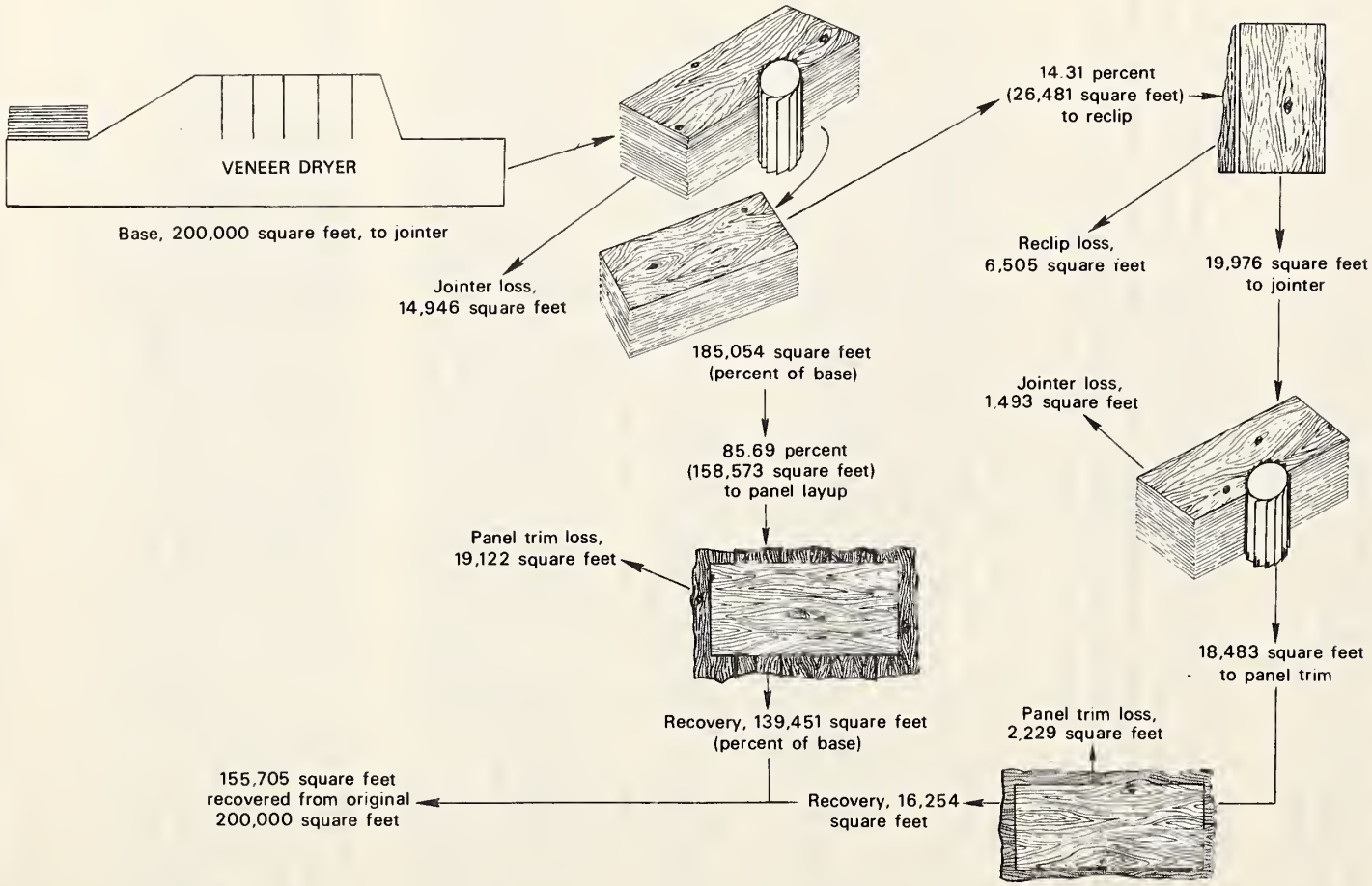

Figure 1.--*Illustration of volume loss from grades A, B, and C, 102-inch random width veneer. (Volumes are in square feet, 3/8-inch basis.)*

Step	Veneer volume Recovery	Loss
	Square feet, 3/8-inch basis	
1. Base: Random width, 102-inch veneer, grades A to C	200,000	
2. Jointing factor, 0.92527 x 200,000 square feet	185,054	14,946
3. Veneer from jointer ready for panel layup, 0.85690 x 185,054 square feet	158,573	
4. Panel trimming factor, 0.87941 x 158,573 square feet	139,451	19,122
5. Veneer from jointer returned to reclip, 0.14310 x 185,054 square feet	26,481	
6. Reclipping factor, 0.75435 x 26,481 square feet	19,976	6,505
7. Jointing factor, 0.92527 x 19,976 square feet	18,483	1,493
8. Panel trimming factor, 0.87941 x 18,483 square feet	16,254	2,229
Recovery (sum of steps 4 and 8)	155,705	
Loss (sum of steps 2, 4, 6, 7, and 8)		44,295

The general plywood industry practice is to edge-joint, glue, or tape half sheets of grade A patch to grade D into full sheets and use them for layup. Rather than develop factors for two loss items, jointer kerf and panel trim, the total loss was computed the same as for full sheets. That is, no kerf loss was applied, but the trimming loss was calculated on the basis of two unjointed half sheets. Volumes of all the half sheets, grades A patch through D, were then totaled, and this volume was reduced by the trimming factor only. This is shown in the example below:

A patch through D, half sheets; volume in square feet, 3/8-inch basis	Loss factor for panel trimming	Final volume
100,000 ⟶	0.12059	87,941

The A grade half sheets used for patch stock are shown in the example below:

A, half sheets; volume in square feet, 3/8-inch basis	Loss factor for patch stock	Final volume
4,000 →	1.00000	0

As previously stated, it was assumed that all 102-inch random width D grade would be used as plywood core stock. This volume plus the volume of all grades of 50-inch random width veneer was reduced by the loss factor for glue spreading. The resultant volume was again reduced by application of the trimming factor. Thus the final volume of all core stock reflected both spreading and trimming losses. This procedure is illustrated in figure 2.

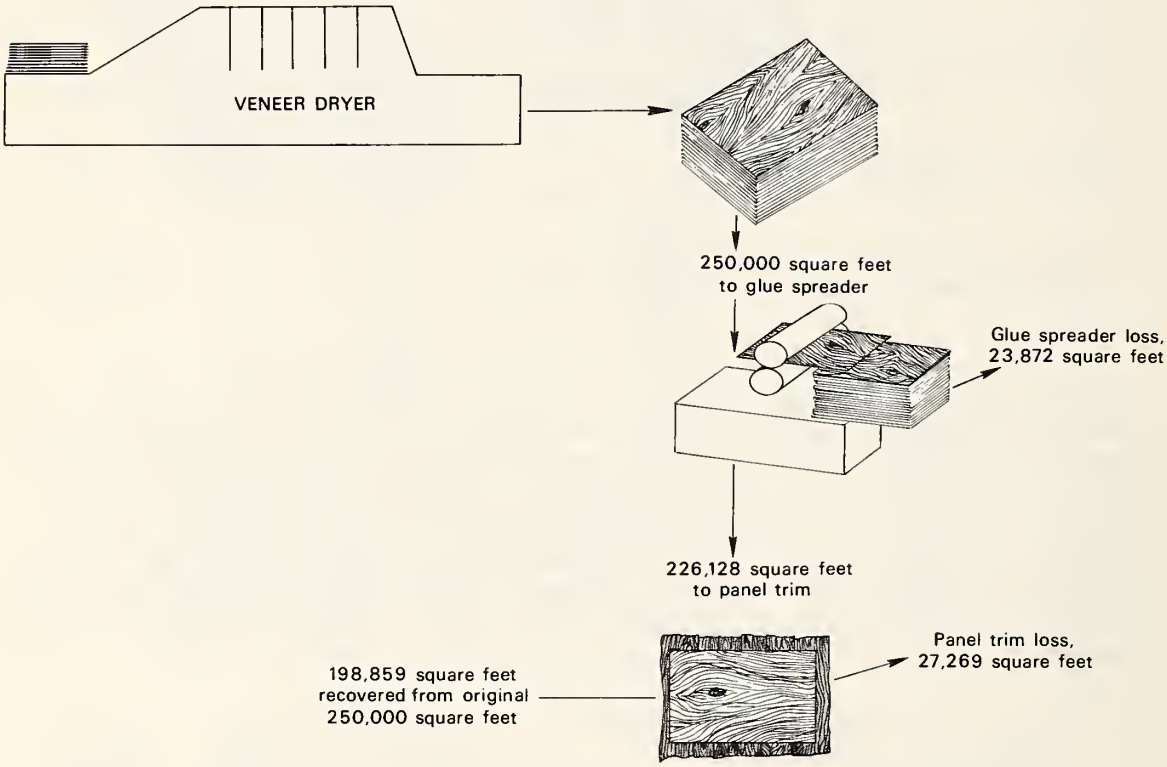

Figure 2.--*Illustration of volume loss factors for all grades 50-inch random width veneer and grade D 102-inch random width veneer. (Volumes are in square feet, 3/8-inch basis.)*

Full sheets of veneer are used in the condition and size they are when stacked out of the veneer dryer or at the patching equipment. The only production loss for full sheets occurs when the laid-up panel is trimmed to finished panel size. Damage-type losses from poor handling procedures in the plant were not measured. Therefore, the volumes of full sheets from all studies were summed and reduced by just the trimming loss factor. This calculation is the same as was applied to the half sheets and is shown in the example below:

All grades, full sheets; volume in square feet, 3/8-inch basis		Loss factor for trimming	Final volume
500,000	→	0.12059	439,705

A single overall factor is determined by a ratio of the final output volumes of all veneer by grade and size as determined by the factors and the original input volumes. This gives a loss factor of 16.3 percent from the total volume of dry, untrimmed veneer tallied at the dry chain to the plywood panel volume at the shipping point.

Veneer item	Veneer input volumes from examples	Veneer output volumes as determined by loss or recovery factors
	- - *Square feet, 3/8-inch basis* - -	
Random width, 102 inches, grades A to C	200,000	155,705
Half sheets, grades A patch to D	100,000	87,941
Half sheets, grade A	4,000	0
Random width, 50 inches, all grades; 102 inches, grade D	250,000	198,859
Full sheets, all grades	500,000	439,705
	1,054,000	882,210

$$\frac{882,210}{1,054,000} = 0.837 \qquad 1.000 - 0.837 = 0.163 \text{ loss factor}$$

Plywood panel sanding loss was not measured during these tests.

CONCLUSIONS

Losses of rough dry veneer between the dry chain and the trimmed plywood panel were determined from a series of detailed studies. Total losses from all sources were found to be approximately 16 percent of the original volume measured at the dry chain. This figure has since been confirmed by one large veneer mill peeling coast Douglas-fir through test procedures similar to these.

The individual volume loss factors will provide an individual veneer mill with factors to estimate output volumes from veneer dryer production volumes. Any mill interested in learning the extent of its losses at the various processing points in comparison with these factors can conduct similar tests and compare their results with those shown here. The factors could also be useful where information on current veneer losses is needed to properly evaluate new processes or equipment.

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